NAG Fortran Library Routine Document

F01CRF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

1 Purpose

F01CRF transposes a rectangular matrix in-situ.

2 Specification

```
SUBROUTINE F01CRF(A, M, N, MN, MOVE, LMOVE, IFAIL)
INTEGER           M, N, MN, MOVE(LMOVE), LMOVE, IFAIL
real              A(MN)
```

3 Description

F01CRF requires that the elements of an m by n matrix A are stored consecutively by columns in a one-dimensional array. It re-orders the elements so that on exit the array holds the transpose of A stored in the same way. For example, if $m = 4$ and $n = 3$, on entry the array must hold:

$$a_{11} \quad a_{21} \quad a_{31} \quad a_{41} \quad a_{12} \quad a_{22} \quad a_{32} \quad a_{42} \quad a_{13} \quad a_{23} \quad a_{33} \quad a_{43}$$

and on exit it holds

$$a_{11} \quad a_{12} \quad a_{13} \quad a_{21} \quad a_{22} \quad a_{23} \quad a_{31} \quad a_{32} \quad a_{33} \quad a_{41} \quad a_{42} \quad a_{43}.$$

4 References

Cate E G and Twigg D W (1977) Algorithm 513: Analysis of in-situ transposition *ACM Trans. Math. Software* **3** 104–110

5 Parameters

1: A(MN) – ***real*** array *Input/Output*

On entry: the elements of the m by n matrix A, stored by columns.

On exit: the elements of the transpose matrix, also stored by columns.

2: M – INTEGER *Input*

On entry: m, the number of rows of the matrix A.

3: N – INTEGER *Input*

On entry: n, the number of columns of the matrix A.

4: MN – INTEGER *Input*

On entry: the value $m \times n$.

5: MOVE(LMOVE) – INTEGER array *Workspace*
6: LMOVE – INTEGER *Input*

On entry: the dimension of the array MOVE as declared in the (sub)program from which F01CRF is called.

Suggested value: LMOVE $= (m + n)/2$.

Constraint: LMOVE ≥ 1.

7: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 for details.

On exit: IFAIL $= 0$ unless the routine detects an error (see Section 6).

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, for users not familiar with this parameter the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

6 Error Indicators and Warnings

If on entry IFAIL $= 0$ or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL $= 1$

On entry, MN $\neq$ M $\times$ N.

IFAIL $= 2$

On entry, LMOVE ≤ 0.

IFAIL < 0

A serious error has occurred. Check all subroutine calls and array sizes. Seek expert help.

7 Accuracy

Exact results are produced.

8 Further Comments

The time taken by the routine is approximately proportional to mn.

9 Example

The example program transposes a 7 by 3 matrix and prints out, for convenience, its transpose.

9.1 Program Text

Note: the listing of the example program presented below uses ***bold italicised*** terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     F01CRF Example Program Text
*     Mark 14 Revised.  NAG Copyright 1989.
*     .. Parameters ..
      INTEGER          M, N, MN, LMOVE
      PARAMETER        (M=3,N=7,MN=M*N,LMOVE=(M+N)/2)
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*     .. Local Scalars ..
      INTEGER          I, IFAIL
*     .. Local Arrays ..
      real             A(MN)
      INTEGER          MOVE(LMOVE)
*     .. External Subroutines ..
      EXTERNAL         F01CRF
*     .. Intrinsic Functions ..
      INTRINSIC        real
*     .. Executable Statements ..
      WRITE (NOUT,*) 'F01CRF Example Program Results'
      DO 20 I = 1, MN
         A(I) = real(I)
   20 CONTINUE
      IFAIL = 0
*
      CALL F01CRF(A,M,N,MN,MOVE,LMOVE,IFAIL)
*
      WRITE (NOUT,*)
      WRITE (NOUT,99999) (A(I),I=1,MN)
      STOP
*
99999 FORMAT (1X,7F7.1)
      END
```

9.2 Program Data

None.

9.3 Program Results

```
 F01CRF Example Program Results

     1.0    4.0    7.0   10.0   13.0   16.0   19.0
     2.0    5.0    8.0   11.0   14.0   17.0   20.0
     3.0    6.0    9.0   12.0   15.0   18.0   21.0
```